

Anatomy of an Ordovician Glacial Palaeovalley Near Tabuk, Northwest Saudi Arabia

Melvin, John¹, Owen Sutcliffe², Thomas Ferebee¹ (1) Saudi Aramco, Dhahran, Saudi Arabia
(2) Neftekh Petroleum Consultants Ltd, Oxford, United Kingdom

The Ordovician Sarah Formation in Saudi Arabia crops out as glacial paleovalleys radiating north and east from the Arabian shield. One such paleovalley, including a shallow well down-dip from the outcrop, demonstrates the mode of formation, and the nature of the depositional fill of these paleovalleys. The feature is flanked by a series of upthrust blocks of lower Ordovician sediments and Ashgillian Zarqa diamictites that are oriented strike-parallel to the paleovalley length. Other upthrust units, striking orthogonal to the axis, are identified along the length of the paleovalley. These glacio-tectonically-induced structures were intimately involved in the formation of the paleo-valley: at maximum glacial advance, subglacial ice-surges loaded down into the softened sedimentary substrate, enhancing the resultant elongate trough by lateral thrusting producing lateral “squeeze” moraines. Subsequent ice-retreat involved minor re-advances that created the cross-valley thrust moraines. These served to compartmentalize the valley feature. This irregular paleovalley floor was draped with extremely coarse-grained, very poorly sorted diamictite, deposited mainly during initial glacial advance. It is overlain by a number of high density gravity flow sandstone facies, exhibiting a hierarchy related to high discharge from a subglacial tunnel valley system. Locally, poorly sorted diamictites also occur. All these sediments represent the products of pulsed glacial retreat, sequentially infilling the thrust-bounded compartments of the paleovalley. The down-valley cores provide evidence for a late stage glacial readvance, with further glaciotectionic deformation, prior to deposition of a thin shallow marine succession suggestive of a final response to post-glacial isostatic uplift.